



## MSC Tests Show Water, Oxygen Available From Lunar Soil

Ten employees of the NASA Manned Spacecraft Center have applied for a joint patent on a simple and practical device and process for recovering water and its constituent elements, hydrogen and oxygen, from lunar soil.

The device is based on a chemical process using hydrogen and solar energy to reduce oxides containing iron, which are constituents of lunar soil, to produce water vapor, which can in turn, be electrolyzed to yield oxygen and hydrogen.

Samples of lunar material returned by the Apollo 11 and 12 astronauts contain significant proportions of an iron-titanium oxide called ilmenite.

The apparatus described in the patent application uses a mirror to focus the sun's rays on a container of lunar soil, heating the soil to between 600 and 1,300 degrees Centigrade. Hydrogen is then introduced into the container and reduces oxygen atoms present in the ilmenite to form steam. The steam is passed through an electrolysis cell which separates the constituent elements of oxygen and hydrogen.

The hydrogen used in the reaction must be supplied initially from Earth, but may be recirculated a number of times to produce more oxygen.

The chemical process has been tested in a laboratory at the Manned Spacecraft Center using simulated lunar soil and has been found feasible. The simulated lunar soil was produced in MSC's Lunar Receiving Laboratory by grinding and mixing the proper proportions of a basalt from Hawaii and ilmenite, obtained from Canada.

The patent application notes that while neither water nor uncombined oxygen has been found on the lunar surface, both can be produced from lunar resources, offering the potential of supporting lunar exploration as well as broader space exploration. Oxygen, for example, could be used not only to support life, but also as a propellant for space vehicles.

Calculations show, with the hydrogen process, 100 pounds of lunar soil would yield nearly a pound of water; and if the iron-bearing oxides are first concentrated magnetically the yield in-

creases to nearly 14 pounds of water from 100 pounds of lunar material.

A number of other chemical reagents are being considered in addition to hydrogen. Fluorine, for example, provides a much greater yield of oxygen, but requires a more complicated process and does not yield water directly.

The hydrogen technique and the fluorine technique for recovering oxygen from lunar soil are being investigated further at the Manned Spacecraft Center and at NASA's Lewis Research Center in Cleveland.

MSC employees named as co-inventors of the hydrogen production process and related apparatus are David S. McKay, Everett K. Gibson, Patrick Butler, Jr., Norman H. Chaffee, Edward I. Chimenti, Alfred P. Sanders, Andre J. Meyer, Hoyt McBryar, T. R. Wellman, and Robin Brett.

## Low Cites Luna, Advanced Soviet Space Technology

George M. Low, Acting NASA Administrator cited the Soviet Union's Luna 17 mission as evidence of that country's advanced state of space technology and broad range of objectives.

In a statement November 17, Low said the "space age has not previously seen such vigorous activity in space as that demonstrated by the Soviet Union in recent weeks. In little more than 60 days the Soviet Union has launched 22 space missions, including Luna 16, which gathered and

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(Top) Ed Cornetius weighs out proper proportion of ilmenite basalt in preparation of simulated lunar soil in MSC's Mineral Separation Laboratory, Bldg. 37. (Bottom) Dr. W. R. Downs, (L) Technical Assistant for Advanced Systems, SMD, BRN Chemical Technician Fred Harper (C) Dewayne Casten (R) monitor water yield of sample in the Materials Composition Test Lab operated by MSC at Ellington Air Force Base.

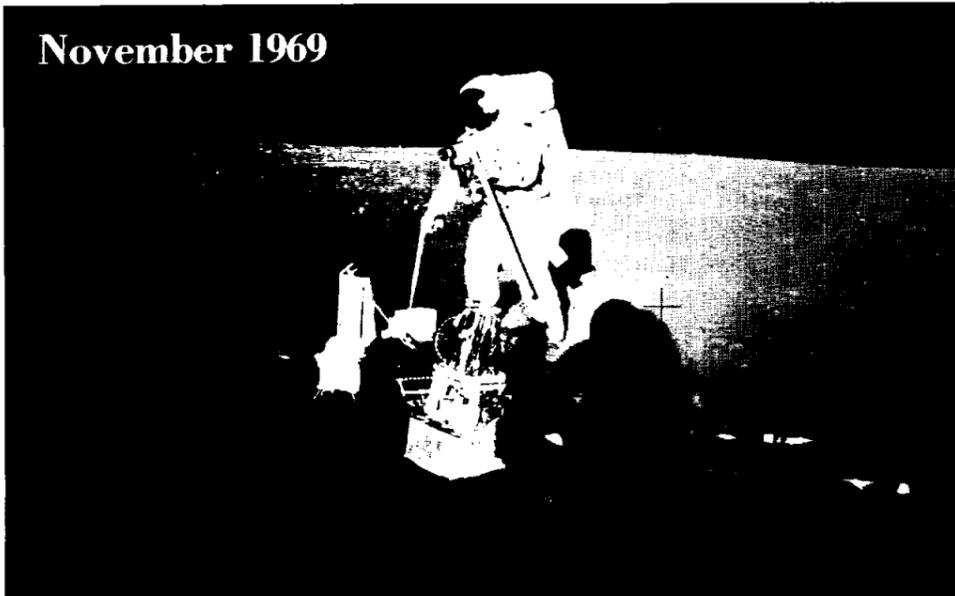
## Center Vote on AFGE Set For Nov. 24

On November 24, 1970, an election will be held to determine whether nonsupervisory employees of the Manned Spacecraft Center who are located in Houston want the American Federation of Government Employees (AFGE, AFL-CIO) to serve as their exclusive representative.

If elected by the majority of voters, the AFGE as exclusive representative would be entitled to act for and negotiate agreements covering nonsupervisory employees in what is termed the "bargaining unit." The union would be given the opportunity to be represented at formal discussions between management and employees, serve as employee representatives concerning grievances, consult on personnel policies and practices, and participate in other matters affecting general working conditions.

All MSC employees are eligible to vote with the exception of man-

November 1969



November 1970



Astronaut Charles Conrad deploys ALSEP near Surveyor Crater in the Ocean of Storms during last year's Apollo 12 mission in photo at left. On the right Ronald Bradford (L) of Bendix Corp. and Keith Kundel of the Flight Control Division man the ALSEP console in the Science Support Room of building 30 where 6,500 commands have been issued to the lunar science package during the past year.

## Agnew & Low Present Top NASA Awards

Vice President Spiro T. Agnew presented the National Aeronautics and Space Administration's highest award — the NASA Distinguished Service Medal—to nine Apollo astronauts and Dr. Thomas O. Paine, former Administrator, at the agency's 12th Annual Awards Ceremony November 13.

Thirty-eight other NASA employees received awards for exceptional service, exceptional scientific achievement, exceptional bravery, outstanding leadership and group achievement from Dr. George M. Low, acting NASA Administrator, at ceremonies in Washington.

Apollo astronauts who received the Distinguished Service Medal from Vice President Agnew, chairman of the National Aeronautics and Space Council, were: Neil Armstrong, Michael Collins and Edwin E. Aldrin, Jr., Apollo 11; Charles Conrad, Jr., Richard F. Gordon, Jr., and Alan L. Bean, Apollo 12; and James A. Lovell, Jr., John L. Swigert, Jr. and Fred W. Haise, Jr., Apollo 13.

Three men from the Manned Spacecraft Center Flight Operations Directorate received the NASA Exceptional Service Medal. They are: Gerald D. Griffin of Flight Control Division who was cited for his role as prime flight director in the Apollo 12 mission; John W. Aaron, also of Flight Control Division, for his rapid assessment of the Apollo 12 electrical anomaly shortly after liftoff while manning the Apollo spacecraft systems console in Mission Control Center; and Floyd V. Bennett of Mission Planning and Analysis Division for his role in designing the Apollo 12 trajectory which resulted in a pinpoint lunar landing less than 600 feet away from the Surveyor III spacecraft.

## Engert, Nunnery Win Golf Honors

The MSC Golf Association held its last scheduled tournament of the year Veterans Day at the El Dorado Country Club. Max Engert had the low gross score of the day with an 80.

Bill Nunnery won the championship flight with a net 70, Jean "Pete" Petersen was second with 72; and Jim White and Bill Shropshire tied for third with 73's. John Frere won the first flight with a net 72; and Pete Smetek, Bob Gordon, and Jim Smith tied for second with 76's. Steve Gorman and Don Travis tied for first place in the second flight with 70's; Bart Batson was third with 78; and Lou Leopold, Bob Lacey, and Ben Hood tied for fourth with 80's.

The MSCGA officials decided to wind up the year's activities with a special fun tournament which will be held at the Sunmeadow Golf Club December 12.



John W. Aaron, ESM



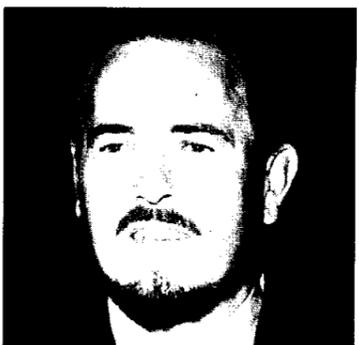
Edwin E. Aldrin, Jr., DSM



Neil Armstrong, DSM



Alan L. Bean, DSM



Floyd V. Bennett, ESM



Michael Collins, DSM



Charles Conrad, Jr., DSM



Richard F. Gordon, Jr., DSM



Gerald D. Griffin, ESM



Fred W. Haise, Jr., DSM



James A. Lovell, Jr., DSM



John L. Swigert, Jr., DSM

## NASA Gets 1-G Rover Trainer

A major milestone in the manned lunar roving vehicle (LRV) program was reached this week when a special training vehicle was delivered to the NASA-Marshall Space Flight Center by the Boeing Co., LRV prime Contractor.

The vehicle, called a "1-G trainer" because it will operate in Earth's gravity, was built for Boeing by its major LRV subcontractor, the Delco Electronics Division of General Motors Corp.

Astronauts Charles Duke and Robert Parker, and officials of both Boeing and Delco Electronics were present at the informal ceremony.

### Delivery To MSC

The 1-G trainer will be shipped to the Manned Spacecraft Center, Houston, and arrive here in about a week. The vehicle will be used in a training program to teach astronauts how to operate the vehicle under many simulated situations.

The 2-man trainer is similar in appearance to the operational version of the lunar roving vehicle, with certain major differences. The biggest of these are that the trainer weighs about twice what the flight LRV will weigh, and the trainer is equipped with automobile-type and wire mesh tires. It is the only operating vehicle that closely duplicates the operational LRV in Earth environment.

The trainer's extra weight comes from additional strength in the frame, wheels, drive motors, and suspension system, caused by the fact that astronauts and their equipment weigh six times more on Earth than they will on the moon. The trainer can carry a total weight of 800 pounds, including two astronauts, scientific equipment and samples. The auto-type tires are necessary because of the trainer's extra weight. Flight LRVs will have special wire mesh wheels.

The trainer is 10 feet, 7 inches long, almost six feet wide, and has a 7.5-foot wheelbase. Each wheel is powered by an electric motor, in conjunction with a three-stage planetary gear box instead of the harmonic drive that will be used on flight models.

### Aircraft Controls

The trainer will be operated with an aircraft-like "stick" hand controller and can stop, turn, move forward and reverse at variable speeds. Top speed will be about nine miles an hour on a relatively smooth surface.

The trainer, like flight LRVs, is designed to negotiate, from a standing start, step-like obstacles one foot high with both front wheels in contact. It can cross, also from a standing start, 22-inch crevasses, even if both wheels rest across the crevasse.

The fully loaded vehicle will be able to climb, descend and stop on slopes as steep as 31 degrees.

Side-by-side seating will enable either astronaut to operate the trainer. Apollo crews can do their training fully suited or in shirt sleeves.

### Apollo 15

The first flight model lunar roving vehicle is planned as a major part of the Apollo 15 lunar exploration mission, scheduled for launch in July 1971 to the Hadley Rille-Apenines Range area. The LRV will be used in up to three extravehicular activities (EVA) of that mission.

During the first EVA the lunar vehicle will be deployed from its folded stowage position in the lunar module's descent stage. It will then be taken on a relatively short geological traverse, lasting about an hour or more.

No special EVA has been set aside just to check LRV performance; the vehicle will fulfill science objectives on its first traverse. During this EVA the vehicle's performance will be carefully monitored, however, before committing it to a more ambitious EVA.

During the second and third EVAs the vehicle will travel between nine and 12.5 statute miles on each traverse. One sortie is planned along Hadley Rille; the other to the Apenines Ridge, and each sortie could extend up to 6 hours. Photographs will be taken and samples collected on both of these excursions.

Communications with Earth will include voice and color television. Voice communication can be made at any time during a sortie, but TV transmission, requiring a high-gain antenna, can be made only while the vehicle is stopped.

## Soviet Space —

(Continued from Page 1)

returned a lunar sample to earth, and Zond 8, which carried out extensive photography in lunar orbit."

"Now Luna 17 with its remote-controlled Lunakhod 1 vehicle is added to the list in a clear demonstration that the Soviet Union is operating with an advanced state of technology and is exploiting it for a broad range of objectives," said Low.

Luna 17 landed in the area of the Sea of Rains on the Moon, November 17 and about 3 hours later deployed the Lunakhod 1 vehicle which the Soviet News Agency, Tass, said would carry out scientific investigations on the surface of the moon at various distances from the landing spot.

# Roundup Swap-Shop

(Deadline for Swap-Shop classified ad is Thursday of the week preceding Roundup publication date. Ads are limited to MSC civil service employees and assigned military personnel. Maximum length is 15 words, including name, office code and home telephone number. Send ads in writing to Roundup Editor, AP3)

### REAL ESTATE

Clear Lake City, 3-2-2, living room, paneled den, built-ins, low equity, R.I.F. Michelli, 488-5500.

House trailer, 3 rooms, bath, good cdt, located at Caney Creek. Make offer. Childs, 534-5944 Dickinson.

Dickinson, 4 bedrooms, 2 baths, 1 1/2 story, 3/4 acre wooded lot, large garage, fireplace. Tucker, 534-2793.

Tiki Island lot, choice bay-front location on Jones Bay. Will consider second lien on assumption, \$2,000 below present market value. Mandell, 877-2925.

Lease day/week remote cabin, deep in national forest, ideal base camp for hunting or just getting away from it all. Leonard, 944-4997

### AUTOS

63 Chevy Pickup, 6 1/2 stepside, \$400. Huber, 877-1726.

69 Volks Sedan, air, radio, tape, 23,000 miles, \$1500. firm. Mason, 591-2707 after 5 pm.

69 Ford LTD, 2-dr hardtop, xln cdt, 4 new tires, maroon/black vinyl top. Puffer, 534-5648 Dickinson.

69 Chevy Deluxe Sportsvan, V8, auto., radio, air, custom interior, ideal for camping or surfing. Bettison, 935-5607.

62 Chevy stepside 1/2 ton pickup, radio and heater, 6-cyl. \$450. Paton, 644-0315.

62 Dodge w/V-8 engine, auto., factory air, 3 good 2 bad tires, in good shapes but smokes, \$175. Leger, 473-2004.

66 Olds Cutlass Convertible, 330 CI, auto, air, P/S, P/B, R/H, WSW, \$1350, Bowling, 932-4813.

63 Chevy Station Wagon, radio, heater, auto, air, P/S, P/B, \$250. Tucker, 471-4055.

70 Toronado, green, black vinyl top, A/C, AM-FM, other extras, plush car. Rainey, 474-2937 Seabrook.

70 Shasta 17-ft travel trailer, self contained, sleeps six. Moore, 474-2118 after 5 pm.

70 Chevy pickup, camper cover, air, other options \$3000, or wil deal for compact car. Zrubek, 591-2549.

66 Opel Kadett station wagon, air conditioning, a real jewel, \$775. Sampsel, 471-0172.

68 Ford Galaxie, 4-dr HT, auto, air, power, 34,000 miles. Stoffels, 474-3862.

62 Chevy wagon, clean, 39,000 actual miles, 6-cyl standard shift, R&H, \$325. Wright, 877-3059.

### PETS

AKC tricolor male Basset Hound, 1-yr old, all shots, show quality. England, 877-1713.

German Shepard puppies, 6-wks old, registered, male & female \$40. Bean, 591-3814.

Half poodle puppies, 6-wks old, \$10. Cota, 487-3794.

Hamster or Gerbil cage, stainless steel w/ exercise wheel, Cost \$8 will sell for \$3. Handley, 482-7041.

### MISCELLANEOUS

Eidiphone Ensign Amplifier, 2 channels, 4 inputs, reverb, tremelo, footswitch, external speaker plug and convenience outlet. Almost new, cost \$295, asking \$200. Peterson, 488-4176.

Wards small upright vacuum \$11., Wards camper mattress \$10., gas heater \$10. Call 472-8208.

Dinette, 5-pc, \$25. Spanish living room, 2-pc \$160. Used 3 months. Autrey, 472-5956.

Classical guitar \$65. Play to appreciate. Gorman, 521-9805.

17' Redgish boat w/75 HP Evinrude, trailer, 2 tanks, anchor, ropes, preservers, Kammerman, 729-3158.

New Sears retread 700x13 tubeless white-wall, \$6.00. Horton, 474-2102.

Homemade patch quilts \$25. and up. Dacron lined, many colors, sizes and patterns available. Hill, 471-4305.

Rug, Karastan oriental, 6 1/2 by 9, headboard/blanket rail, double bed. Make offer. Critzos, 591-2271.

Tudwig snare drum, stand & carrying case, xln cdt, \$55. Jaschke, 471-4342 after 6 pm.

Electric guitar double pickup amp tremelo and reverb, carrying case, \$150. Jaschke, 471-4342 after 6 pm.

HO gauge, 2 gear drive train sets in original box, AMP pack power, extra track, cork road-bed, many switches, bridges and unbuilt models, cost \$150, sell for \$74. Electronic organ, Thomas Musicale, 2 manuals, 13 pedal bass, walnut spinet, \$350. Jaschke, 471-4342 after 6 pm.

Santa Special model trains (3 sets) collector's items, O-gauge, extra track and switches. Make offer. Must see to appreciate. Sisson, 474-2295.

Snowco Model 800 boat trailer (8" wheels) \$35. or best offer. Becker, 484-5118.

White Storkline baby bed and mattress, good shape \$25. GE dryer, good cdt \$15. Twin bed mattress and box springs 4 mo. old \$25. Westinghouse Refrig and freezer, model RT120-LRW2, 4 mos. old \$150. Palmer, 877-1167 evenings.

IBM electric executive typewriter, xln cdt \$250. Hansen 932-5203.

Good practice piano, upright, antiques driftwood with bench. Available at Christmas \$150. Laughon, 534-5057.

Ruger single six .22 cal., 6 1/2 in. bbl. magnum cylinder w/cartridge belt and holster. Xln cdt \$57.50. Musgrove, 488 3966.

Beautiful dining room suite, includes table w/3 extra leaves, six chairs, buffet and china cabinet \$650. Call 649-2569.

Membership in Clear Lake Country Club, \$75. plus transfer fee. Moran, 488-4086.

8mm Movie Camera and projector. Very reasonable. Duke, 477-1389.

Baby Bassinet. hooded w/pad and skirt, xln cdt, cost \$20, will sell for \$10. Handley, 482-7041.

300 Savage, model DL, 1-yr old, like new, scope, sling, case butt pad. Value \$194, sell for \$135. Haines, WA6-4333.

Concord 727 Tape Recorder, solid State Stereo, speakers 14"x10", used less than 8 times, 1-yr old. Fairbank, 932-2264, after 5:30 pm.

Sekonic model 100 8-mm zoom lens movie camera f/1.8 single lens reflex, auto exposure, runs 50 ft of film w/out reloading. Xln cdt \$45., or trade for 35mm. Tucker, 471-4055

Room for rent, single male, residential home close to NASA. Call 877-4314 after 4:30.

EICO mono FM tuner, stereo amplifier, EV princess speaker \$100. Zrubek, 591-2549.

Mark 10 Target rifle, xln cdt, sling included \$40. Rhythm guitar w/amplifier, xln cdt \$45. Lizza, 932-4663.

Three piece fruitwood bedroom suite with mattress, \$125 cash. Law 944-7596.

GE 14 cu ft refrigerator, xln cdt \$50. Baby scales \$3. Electric sterilizer \$3. GE baby dish \$2. Assorted maternity clothes, sizes 12 & 14. Moore. 488-2204.

Early American Truetone 23" color TV, recently overhauled, reasonable. Rafuse, 932-2468

Golf clubs, 4 irons, 2 woods, putter, bag, good starter set. Smith, 748-2251.

Flute, Artley, good condition w/case \$125 or best offer, HUB-3484 or 932-2857.

Mossberg model 144 LSA 22 target rifle like new \$30. HUB-3484 or 932-2857.

Ski Rig complete 14' fiberglass Lone Star boat with 35 Horse Super Seahorse motor and electric starter, Road King tilt trailer fully equipped with many extras, all in perfect condition, first \$650 gets it all. HUB-3484 or 932-2857.

### 20 YEARS



Downey QAO's (l to r) Elmer G. Hardaway, Robert L. Seidel, Arthur V. Torres.

## Cafeteria Aids Weight Watchers

The MSC Cafeterias have made several innovations recently to increase the selection of foods while holding the line on prices.

A special low calorie serving line is being offered on an experimental basis in cafeteria 1. This special service offers a controlled menu to make it easier for the weight watchers at MSC to enjoy a variety of foods, while keeping the waist line trim. This low calorie menu service will be expanded to include cafeteria 2 if the current trial period proves customer demand.

For those who desire a change in their lunch menu, the cafeterias

now offer a variety of nine or twelve inch pizzas. The pizzas will be baked to order, and advance orders must be placed to telephone extension 5905. A price list for the complete pizza line is posted in the cafeterias.

With the Thanksgiving and Christmas holidays approaching, the cafeterias are ready to provide special catering services for office luncheons, and will bake cakes or other pastry products to order, prepare hors d'oeuvres and party sandwiches. The cafeteria is also taking orders for complete Thanksgiving dinners priced at \$13.75. Orders may be placed by calling extension 5905.

Model 41 Bolt Action single shot 22 rifle shoots short-long and long rifle \$20. HUB-3484 or 932-2857.

Monolux Variable power telescope 15, 30, 45 & 60 power with tripod \$35. HUB-3484 or 932-2857.

Racing "Go-Cart" extra Heavy Duty Dual Motor mounts equipped with one 10 Horse West Bend Engine, excellent condition, \$225 or best offer. HUB-3484 or 932-2857.

Philco color TV Console, one owner, good condition, \$100 firm. Strickland, 946-7173.

175CC Honda 1969, Buddy seat, turn signals, clean, tangerine, 4,000 miles. Consider small motorcycle trade. Wright, 877-3059.

### WANTED

Good home for small female black dachshund dog. Good with children. Cohen, 488-3171  
Used go-cart or mini-bike, less engine. Wilson. 877-2839.

## AFGE—

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anagerial officials, supervisory personnel, Wage Grade employees, personnel assigned to the Model and Plastics Branch of the Technical Services Division, temporary employees, military personnel and contractor employees.

Professional employees have the option of voting whether or not to be included in the same unit with nonprofessional employees and whether or not they wish to be represented by the AFGE. Professional employees include engineers and scientists, medical professionals, accountants, attorneys, librarians, and historians.

The election will be supervised by representatives of the Department of Labor. Polling places, voting schedules and additional information regarding the election have been provided in an MSC Announcement and in the Notice of Election. This Notice has been posted on all official bulletin boards of buildings occupied by MSC employees.

All eligible employees are encouraged to vote so that the results of this election will be representative of the majority.

AFGE Local 2284 will hold an open meeting Monday, November 23 at 5 p.m. in the building 30 auditorium to answer questions from employees regarding the coming election. Interested persons and AFGE members are urged to attend.



Astronaut Thomas P. Stafford briefs Soviet Cosmonaut Andriyan Nicolayev on the finer points of launch pad aborts as part of an MSC tour given Nicolayev and fellow Cosmonaut Vitaley Sevastianov October 23. Lower left Rita Rapp and Dr. Malcolm Smith of MSC's Food and Nutrition Team demonstrate space food packaging techniques while Sevastianov (L) and Nicolayev (2nd from L) sample the product along with Astronaut Edwin Aldrin (C). Lower right Crew Systems Division Chief R. E. Smylie points out features of the Apollo liquid cooling garment.

## Photo Support Contract Awarded To Technicolor

The National Aeronautics and Space Administration has selected Technicolor Inc., Hollywood, California, for award of a contract to provide photographic and audiovisual support services at the Manned Spacecraft Center.

Estimated value of the cost-plus-award-fee contract for one year is \$1.5 million. The contract begins December 1, 1970 and contains provisions for four one-year extensions.

The new contract consolidates work presently performed under contracts with A/V Corp. and Data Corp as well as small amounts of two other contracts.

Six firms submitted proposals for the new consolidated contract.

Technicolor, Inc. will provide photographic sciences, high precision and general photographic laboratory services, film library and audiovisual services in support of the MSC Photographic Technology Laboratory.

## Ninth Saturn V Goes To Pad

Apollo 14 astronauts Alan B. Shepard, Stuart A. Roosa and Edgar D. Mitchell were on hand at Cape Kennedy November 9 to view the rollout of their spacecraft and launch vehicle.

The crawler-transporter began moving its 12½ million pound load from the Vehicle Assembly Building at 6:31 a.m. and reach-

ALSEP—

(Continued from Page 1)

information can then be displayed electronically or printed out in the Science Support Room on the third floor of building 30.

For the first 45 days after ALSEP was emplaced on the Moon scientists and flight controllers monitored its performance around the clock. This intensive monitoring was gradually reduced as operations became more routine; and active monitoring now consists of a 24-hour support phase associated with each lunar sunrise and sunset, one-hour support periods every two or three days during the lunar night, and daily support periods of between two and six hours during the lunar day. Active monitoring also takes place during periods of special interest such as solar eclipses.

ed its destination atop Pad A 3½ miles away at about 12:15 p.m.

The Apollo 14 vehicle was the ninth rollout at launch complex 39 and came on the third anniversary of Apollo 4, the first Saturn V launch.

Command Module Pilot Roosa talked with newsmen at the Cape during the rollout and said everything appears to be on schedule for a January 31 launch.

### Spacecraft Modifications

Asked to describe modifications made to the Apollo 14 spacecraft as a result of the Apollo 13 accident, Roosa said the two major changes were the addition of a third oxygen tank physically sep-

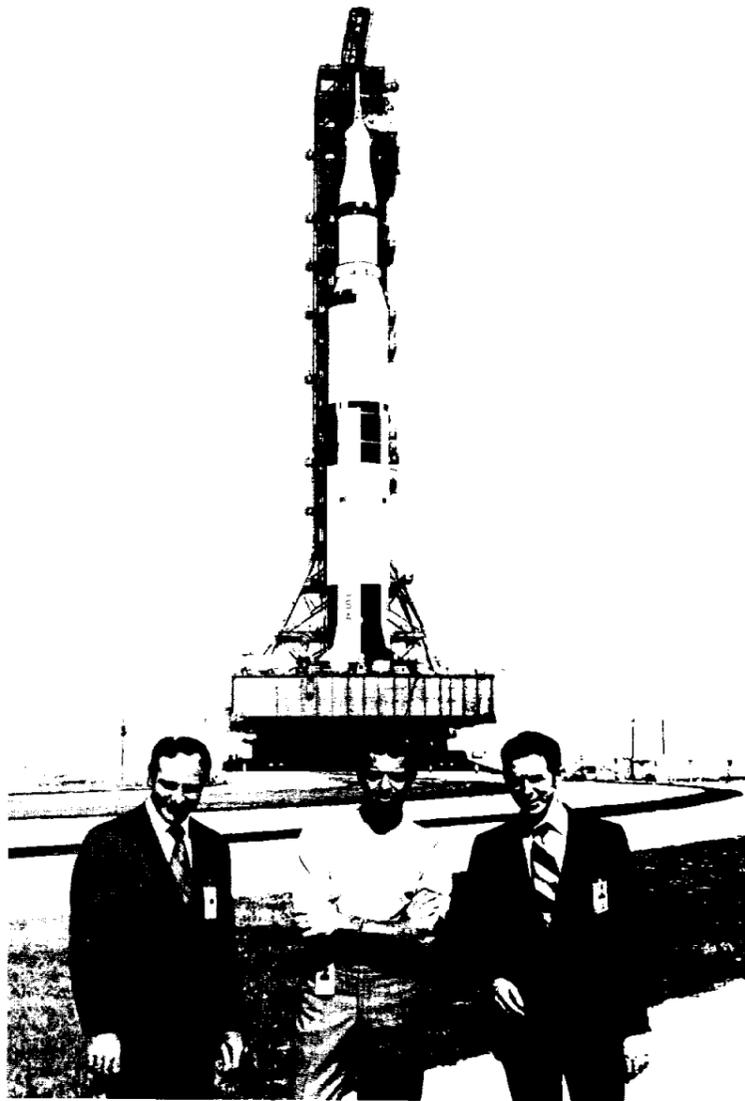
Data presented in the Mission Control Center was the main reference for scientific investigators early, "quick look" reports and initial assessments. For their detailed analyses, however, the scientists rely on copies of magnetic tape ALSEP telemetry data shipped to them via MSC from each of the remote receiving sites. These tapes contain all of the ALSEP data received on earth, and can be replayed as required for different types of processing.

arated from the other two tanks on the other side of the Service Module and the addition of a Lunar Module descent battery to the Service Module to provide emergency electrical power in the event of fuel cell failures. Roosa said profiles have been analyzed showing that with the loss of all three fuel cells at any point in the mission it would still be possible to return home safely without having to utilize Lunar Module power.

Following liftoff from the lunar surface Shepard and Mitchell will use rendezvous techniques pioneered on Gemini 11 by Conrad and Gordon—the so-called M = 1 or direct ascent rendezvous.

### Television

Asked to describe the Apollo 14 TV schedule, Roosa said, "We're going to show TV of the docking; we'll show TV, on the way out, of the entrance into the LM; we'll have a TV show in lunar orbit prior to the Descent Orbit Insertion burn while we're still in the 60 by 170 mile orbit, showing the Fra Mauro area and hopefully . . . the landing site up to the north." On the way back from the Moon he said a TV transmission is currently planned to show some small onboard experiments.



Astronauts Edgar D. Mitchell, Alan B. Shepard and Stuart A. Roosa pose in front of the stack they will ride to the Moon next January.

## MSC Office Seeks New Uses For Space Technology

During the coming year the MSC Technology Utilization Office will review about 800 new developments in technology arising out of research and development work by NASA employees and contractors.

According to John T. Wheeler, MSC Technology Utilization Officer, about 100 of these developments will represent significant new contributions to some facet of technology that can be adapted to non-space uses.

These are some of the so called "spinoffs" from space research. To date more than 3,000 of these technological developments have been documented in NASA Tech Briefs and have been made available to the industrial, educational, medical and professional community.

The MSC Technology Utilization Office and similar offices at other NASA field centers have the primary responsibility for gathering and reporting new technology to the NASA Headquarters Technology Utilization Office, which prepares and distributes the Tech Briefs periodically to about 8,400 potential users.

Wheeler, who has headed the Technology Utilization Program at MSC since 1962, said the eight or nine Tech Briefs generated by MSC each month result in about 200 inquiries for further information by persons, and outside organizations interested in applying the technology to their own needs.

Although the number of questions indicates significant outside interest in new technology, Wheeler notes that it is difficult to assess how much of this technology is finding its way into new consumer products and industrial processes. Manufacturers are understandably reluctant, he says, to reveal their latest proprietary techniques and processes to competitors, and for that reason there is little feedback on how new technology is being used.

Numerous examples of "spinoff" from space research have been documented, nevertheless, and a number of these samples were cited by former Administrator Thomas O. Paine in testimony before the Senate Committee on Aeronautical and Space Sciences.

A tungsten fiber-reinforced nickel superalloy that is four times as

strong as conventional nickel-base superalloys is described in Tech Brief 68-10369.

Computer programs developed for use in the space program have been made available to outside organizations at a fraction of their development cost.

An MSC contractor developed a thermocouple which can continuously monitor the temperature of a spacecraft heat shield over the range of -250 degrees to +5,000 degrees Fahrenheit. Sensors of this type may be used in metal treating furnaces and in other high-temperature reactive environments. A West Coast firm is integrating these thermocouples into its product line.

MSC's Medical Research and Operations Directorate reported the development of a new bio-

instrumentation device which became the subject of a Tech Brief and which is also being used in monitoring heart patients. The device, perfected by Dr. William Kubiack, University of Minnesota School of Medicine under an MSC contract, allows doctors to determine the volume of blood pumped by the heart per unit time simply by attaching electrode bands around the patient's neck and chest.

Although Tech Briefs are the most common medium for disseminating information on useful new technology, many of the 800 innovations reviewed annually by Wheeler's office will be reported in other specialized publications.

*TU Compilations* provide a collection of many related ideas in a single book covering the general subject. These describe briefly such subjects as "Machine Shop Measurement" and "Tools, Fixtures, and Test Equipment for Flat Conductor Cables."

*Technology Utilization Reports* describe innovations of special significance or complexity. These are more detailed announcements than Tech Briefs and bear such titles as "Joining Ceramics and Graphite to Other Materials."

*Technology Surveys* consolidate the results of NASA-sponsored research-and-development efforts which have advanced whole areas of technology. Noted authorities on the subject write these "guidebooks" for NASA to help others

benefit from the accomplishments described. Magnetic tape recording, solid lubricants, thermal insulation systems, high-velocity metalworking, and advanced valve technology are examples of the topics that have been surveyed.

*Conference Proceedings* are also published to disseminate the results of meetings and papers presented by scientists and engineers who have made major contributions to various areas of technology. Conferences on "Pavement Grooving and Traction Studies," "Selected Technology for the Electric Power Industry," and the MSC conference on "Materials for Improved Fire Safety" are typical examples.

The Technology Utilization Office is aided in collecting new technological developments by the Space Act of 1958, which requires that all new technology resulting from work under a NASA contract be reported promptly to NASA. Patent applications filed through the MSC Patent Counsel are another source of new Tech Briefs. Wheeler also encourages individual employees to contact his office, not only on patentable inventions, but on any new or improved product, device, material, process, method, technique, composition, system, machine, apparatus, article, fixture or tool. Individuals contributing to Tech Briefs normally receive a cash award of \$25 each.



Technology Utilization Office staffers from left to right are: Bill Chmylak, Brad Jackson and Manager, Jack Wheeler. Not shown is secretary Helon Crawford.